(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 December 2003 (31.12.2003)

PCT

(10) International Publication Number
WO 2004/001488 A1

(51) International Patent Classification[7]: G02F 1/01, 1/1347, G02B 27/22, H04N 7/18

(21) International Application Number: PCT/NZ2003/000133

(22) International Filing Date: 25 June 2003 (25.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
519735 25 June 2002 (25.06.2002) NZ

(71) Applicant *(for all designated States except US)*: **DEEP VIDEO IMAGING** [NZ/NZ]; Airport Rd, RD 2, Mystery Creek, Hamilton_2021 (NZ).

(72) Inventor: **SMITH, Steven, Traviss**; 2275 Hood Drive, Thousand Oaks, CA 91362-2423 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **ENGEL, Gabriel, Damon** [US/NZ]; Airport Road, RD 2, Mystery Creek, Hamilton 2021 (NZ).

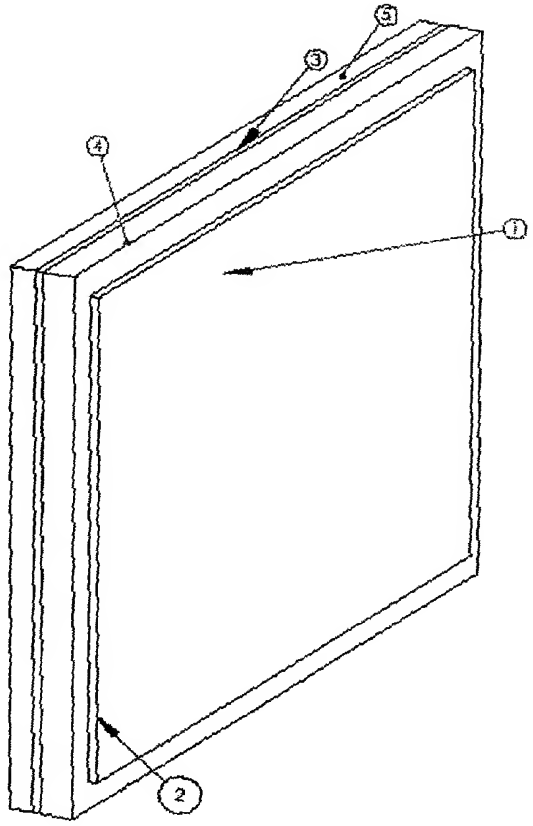
(74) Common Representative: **MACFARLANE, Rodney**; Intellectual Property and Commercial Counsel, Deep Video Imaging Limited, C/-Lowndes Associates, PO Box 7311, Wellesley Street, Auckland (NZ).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),

[Continued on next page]

(54) Title: REAL-TIME MULTIPLE LAYER DISPLAY



(57) Abstract: A multi-layer display system (1) consists of at least two display layers: a front display layer (2) and a rear display layer (3). At least one display layer displays real time information from sources within the light of sight of the display system (i.e. from sources located behind the display system).

WO 2004/001488 A1

Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

REAL-TIME MULTIPLE LAYER DISPLAY

TECHNICAL FIELD

This invention relates to the field of electronic information display.

BACKGROUND ART

Real time operation or monitoring of many machines, vehicles and processes (hereafter called machines) requires the observation of a multiplicity of parameters simultaneously with viewing the implementation of the activity or process being carried out by the system. In some cases this is achieved by the use of a "head-up display" system (HUD) in which images of the most significant instrument readings are projected into the operator's view of the process at a plane coincident with the position of the activity by means of a partially reflecting intermediate screen in front of the operator through which the principal activity is viewed. The said screen needs to be at an angle of around 45 degrees with respect to the vertical plane. For example in a fighter aircraft the pilot views the region external to the aircraft through a conventional windscreen and side windows, but sees the primary instrument readings by reflection from a semi-transparent screen interposed between his eyes and the windscreen. The projection of the instrument readings via the semi-transparent screen is arranged to be "at infinity" or effectively at the same distance from the pilot as the external region so that no focal adaptation of the eyes is required to see the instrument readings.

Another method of operating machines, especially remote controlled or inaccessible machines, requires viewing an image of the activity or process on one or more display screens. Typically additional screens are used to display instrument readings so that the operation of the machine can be monitored and controlled. In many cases it is very important that the operator is able to be continuously aware of the most significant instrument readings while operating the machine.

Despite its advantages, the HUD is a cumbersome system. The need for a partially reflecting screen at about 45 degrees to the vertical in front of the operator creates problems including cluttering the cockpit. The projection system takes up space that designers would prefer to use

for other purposes. In order to use the HUD effectively, the operator has to keep their head within a limited area.

A method of displaying a view of the activity or process on a video screen placed behind another transparent video screen which displays the significant instrument readings or parameters of the machine and which allows the operator by moving their head to see around any displays on the front screen would provided all the benefits of the HUD system while avoiding the need for a cumbersome angled semi reflecting screen in front of the operator. When used to operate remote controlled or inaccessible machines, the use of a multilayer screen with the instrument readings or relevant data displayed on the transparent front screen and the activity or process displayed on the back screen, the benefits of a HUD display could be provided without the activity or process area being accessible to the operator.

At present there exist methods to produce displays where several imaging planes are stacked with set distances between them. These imaging planes may also be stacked as closely as possible. In a preferred embodiment these displays consist of a high-brightened backlight, a rear image panel which is usually an active matrix, colour display, a diffuser and a front image plane, which are laminated to form a stack. There are generally colour filter stripes, and a black matrix on each display which defines the borders of the pixels. However it should be appreciated that the following discussion applies to all image planes that are addressed by passive or active matrices or have colour filters arranged in any periodic pattern. For the purposes of the present invention these image planes may not be addressable at all.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

DISCLOSURE OF INVENTION

Accordingly a first aspect of the current invention comprises a display system for viewing real time images and information comprising, at least one display device to which real time information from sources within the line of sight of the display system is fed such that said

display device(s) is (are) displaying real time information from sources within the line of sight of the display system.

The term 'real time information' as used herein should be interpreted to mean any information such as (without limitation) images, infra-red readings, ultrasound information, sounds and aural data, data relating to the operation of a machine or machine(s), temperature, GPS or any data about the local environment which is taking place or fed to the display device in real time.

The term 'line of sight' as used herein should be interpreted to mean the line of sight in the direction that the rear of the display system is facing. Typically it is the point of view of a viewer, viewing the display device from in front of that display device. But may be broader than the line of sight of a human.

Preferably the scope or breadth of the line of sight within which real time information is fed to the display device can be manipulated by a user to be narrower or broader depending on the user's preference.

As such the present invention is a display device whereby the viewer is presented with information in relation to the current environment in which the viewer is located.

Accordingly a further aspect of the present invention comprises a display system for viewing real time images and information comprising, at least one multi layer display device to which real time information from sources within the line of sight of the display system is being fed such that said multi layer display device(s) is (are) displaying real time information from sources within the line of sight of the display system.

Preferably the multi layer display device consists of at least two display layers at least in part over lapping with the foreground layers being transparent or partially transparent.

Accordingly a further aspect of the current invention comprises a display system for viewing real time images and information comprising, at least one display device to which real time information from sources within the line of sight of the display system is fed such that said display device(s) is (are) displaying real time information from sources within the line of sight of the display system and additional information which is related or unrelated to the real time information being displayed can also be displayed.

As such the viewer of the display system is able to have access to both real time information within the line of sight of the display system along with additional information which may for example assist and/or instruct the viewer in interpreting the real time information being displayed and interpreting the surrounding environment.

Said additional information may be real time or non-real time information. The source of that information may also be from outside the line the not within the line of sight of the display device.

Accordingly a further aspect of the current invention comprises a display system for viewing real time images and information comprising, at least one display device to which real time information from sources within the line of sight of the display system is fed such that said display device(s) is (are) displaying real time information from sources within the line of sight of the display system where said real time information can be manipulated by a user in order to control or assist the operation of a machine.

Reference throughout this specification is made to the present invention as applying to video display systems However, it should be appreciated by those skilled in the art that other types of display and imaging systems may be used in conjunction with the invention, not necessarily being video screens.

In a preferred embodiment of the present invention there is provided a method of displaying an activity or process occurring in real time for the benefit of one or more operators while simultaneously allowing the said operators to view instruments readings or data relevant to the operation of a machine providing the process or activity in the manner of a HUD wherein

a) the activity or process is viewed by a video camera and the image displayed on the rear screen of a multilayer screen system containing a separate rear screen and a transparent front screen parallel and directly in front of the said rear screen,

b) The most significant real time instrument readings or data, critical real time messages or other relevant information is displayed on the front transparent screen in such a manner that it does not significantly obscure the view of the rear screen,

c) the front and rear screens are separated in space so that the operator can easily shift their head to look around displays on the front transparent screen to see details on the rear screen that

were obscured in their original head position,

d) data on the front screen can be manually or automatically changed or displayed in sequence and selected in real time for its significance so that the operator is able to get a broad and appropriate idea of the said parameters as the machine is operating without having to look away from the said display or look at other separate screens,

e) where appropriate, idealised or schematic images or pictures or images or samples or models can be displayed on the front screen for comparison with the real time images on the rear screen to assist the operator in achieving the required objectives, or identifying objects displayed on the rear screen, and

f) the camera or cameras presenting the images of the activity of process to the rear screen can be selected, moved, varied in focus, magnification or position as required, and can operate in a split screen or full screen mode as selected.

For this invention, the basic display system may comprise two parallel coaxial video display screens typically separated by between 15 and 100 millimetres. The rear screen is the same size as or larger than the front screen in order to minimise the viewing effect similar to that of looking through a window. The front screen is transparent except where a display is produced so that the rear screen is normally clearly visible through the front screen. Typically a backlit liquid crystal display is used for the front screen with the back lighting being provided by or through the rear screen which is commonly but not necessarily another liquid crystal display screen.

The present invention displays a real-time representation of the actions scene, activity or process on the rear image plane of a multilayered display. Data or instructions from sensors, instruments, diagrams, samples or other relevant information which relates to the machine or operator or operation may be overlaid upon the scene on the front image plane. For example, in an aircraft, the real time view from the cockpit or front may be displayed on the rear screen, while parameters such as airspeed, altitude, heading, and position and the like are displayed on the front screen. From time to time other relevant or urgent parameters or messages may also be displayed on the front screen as well as or in place of other data. Since the distance between the two displays is controllable at manufacture the operator will not have to spend unnecessary amounts of time refocusing or searching in changing their view between the two representations

of information thereby maintaining better situation awareness.

Where pixel image details on the rear screen are obscured by displays on the front screen, it is simple for an operator to shift sideways and physically look around the front display to see the otherwise obscured details on the rear screen. This improves the applicability and versatility of the system in this invention. It is therefore satisfactory to display the video image of a scene, operation, process or activity on the rear screen while displaying data or information on the front screen for the benefit of the operator or viewer. By this means, data or quantitative information on the front screen is easily absorbed by the viewer while they can simultaneously appreciate and react to the view seen on the rear display. Furthermore, as both screens are viewed simultaneously, the viewer is not forced to refocus on other data sources as would be the case if instruments were displayed on another display system as has generally been the case.

In many processes and activities it is useful to compare a real object or real scene with a schematic, model or ideal scene in order to allow an operator to interact with or control a machine. The system of the present invention readily allows this by typically having the real time scene displayed on the rear screen, and the schematic or idealised scene displayed in part or whole on the front screen of the system.

When an operator is controlling a machine, generally relevant data can be displayed in succession on the front screen to allow the operator to carry out any actions reactive to this data. Furthermore, warning messages, instructions and other data can be displayed in front of the operator and are automatically seen by the operator so that they can be reacted to or implemented. This is more immediate and more certain than conventional system where the messages and data are displayed on separate system which can only be seen or read when the operator takes their eyes away from the real time scene displayed, in this invention, on the rear screen.

In another embodiment the invention may comprise a tiled array of multilayered displays with one or more cameras relaying information to the rear screens as described above. By this means an exterior scene would be displayed on the rear image plane of the array while other relevant information or data is displayed on the front image plane of the said array. This again would allow viewers to avoid having to change focus while studying or using the display and comparing or applying information provided on the front screen to help understand or control or manipulate the system in respect of the processes being displayed on the said rear image plane.

It should also be appreciated that the cameras may be displaying a scene in a dissimilar geographical location to the said array. For example the array may be in United States and the image shown may be of the European Alps. In this form of the invention a said array may be used for illustrating or demonstrating attractive or eye-catching visual displays to the public on the rear screen array while providing advertising or documentary material related to the display on the front screen array.

In yet another embodiment, the invention can be used for teaching, demonstrations, promotion advertising or the like by showing real time or recorded images on the rear screen while appropriate or related data, information, advice, instruction, advertising or promotion material is displayed on the front screen. The material displayed on the front screen may be displayed continuously or intermittently and may be varied to relate to the images being shown on the rear screen. Additionally, the images shown on the rear screen may be varied, controlled or selected by an operator or viewer according to their interests, progress or requirements.

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1 is an oblique diagrammatic view of a display system in accordance with one embodiment of the present invention.

Figure 2 is a diagrammatic side view of a display system in accordance with one embodiment of the present invention.

BEST MODES FOR CARRYING OUT THE INVENTION

A preferred embodiment of the current invention is a hand held multi layer display device for the display of real time and other information. On the rear of this device are input sources such as a camera, an infra-red sensor, a digital thermometer, an ultrasound horn, and other input devices and sensors. Information from those sensors and devices is fed to a CPU or controller which in turn displays the information (or some of it depending on user preferences) on the layers of the multi layer display. In a preferred embodiment, the images from the camera are displayed on the rear layer of the display device with additional information such as temperature being displayed on the front display layer(s). The layer on which information is displayed is chosen by the user or

presets information.

In a further preferred embodiment of the current invention the display system acts as if it were a window on the inside of a vehicle such as a plane, tanks, or other. In this embodiment the display device displays the view presented to the camera which is such that the viewer can in effectively see outside the vehicle.

Figures 1 and 2 illustrate a display system generally indicated by arrow 1. The front screen 2 is separated from the rear screen 3 by a block of clear acrylic material 4 which also provides mutual support for the two screens. Backlighting for the system is provided by a backlight 6 behind the rear screen 3, the backlight being shielded by the cover 5. The front screen is transparent in all regions except where a display is activated.

In operation, a video display of a real time scene or process being taken by a video camera is applied to the rear screen 3. Instrument readings, which may be pictures of instruments or simply numbers associated with captions, diagrams, messages, data and other material are displayed by standard video processes on the front screen 2 as appropriate. In general displays of routine readings and data would be confined to the periphery of the front screen while urgent messages and important material would typically be displayed across the centre of the front screen. Displays on the front screen would normally have a high degree of transparency to minimise obscuration of the rear screen

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

WHAT WE CLAIM IS:

1. A display system comprising at least one display device to which real time information from sources within the line of sight of the display system is being fed such that the display is displaying real time information from sources within the line of sight of the display system.

2. A display system as described in claim 1 where at least one of said display device(s) is a multi layer display.

3. A display system as described in either of claims 1 or 2 where additional related or unrelated information can be displayed on said at least one display device.

4. A display system as described in any of claims 1 to 3 where said real time information can be manipulated by a user in order to control or assist the operation of a machine.

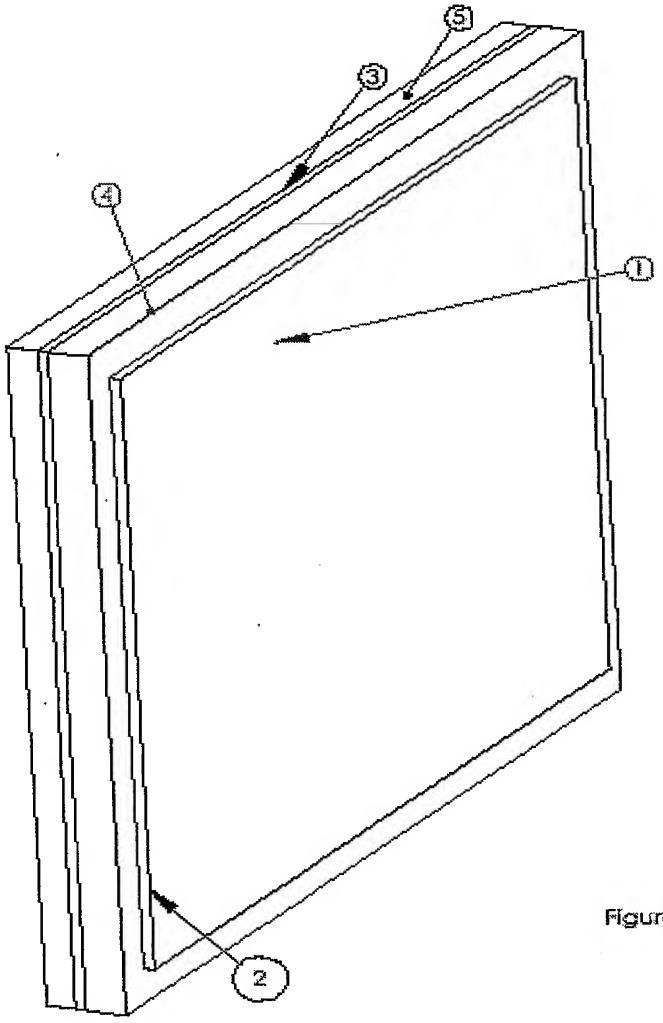


Figure 1

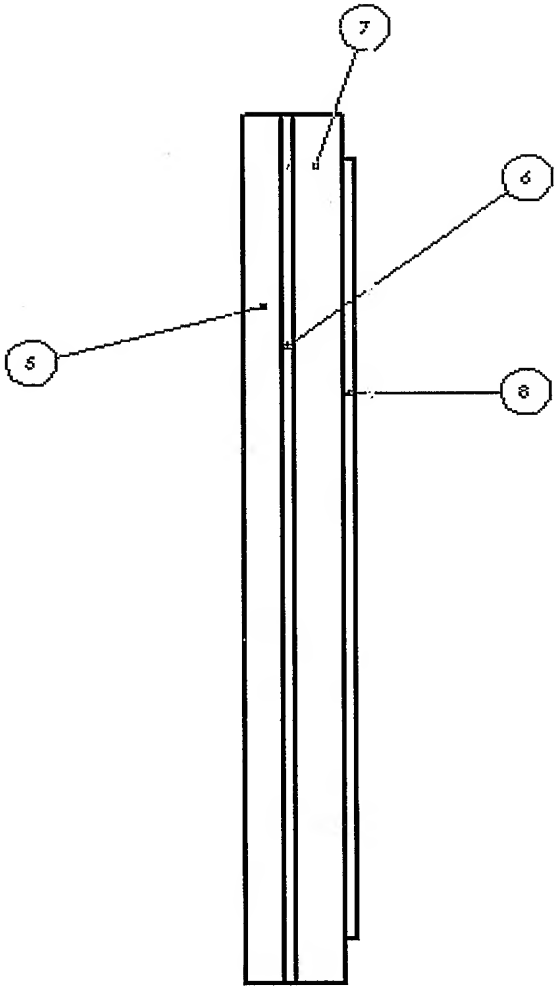


Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ03/00133

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: G02F 1/01, 1/1347, G02B 27/22, H04N 7/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI: screen? or display+ or (light (w) valve?) or (liquid (w) crystal?), +layer+ or front or back or rear or several or stack+ or laminat+ or foreground or two or parallel or overlap+ or overlaid or overlay+ or beneath or film? or coat+ or superpos+ or multi+ or many or dual+ or "2" or upper or sandwich+ or background or plural+, read+ or parameter? or data or indication? or information or message? or date or record? or logo? or text? or indicia or image? or picture?, (real (w) time) or video+ or continuous+ or "closed circuit" or live, /ic G02F-001 or G09F or G09G or G02B-027 or H04N or B60 or B64D, (screen? or display?) (s) (transparent or clear+ or "see-through" or transmissive), "line of sight" or "point of view" or "in front of", machine? or vehicle? or +craft? or navigat? or car? or automobile? or aeroplane? or submarine? or tank? or camera, "head up", and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5978607 A (TEREMY et al.) 2 November 1999 Abstract, Claim 17	1-4

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 September 2003	13 OCT 2003
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **RAJEEV DESHMUKH** Telephone No : (02) 6283 2145

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ03/00133

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99/32945 A1 (ASULAB S.A.) 1 July 1999 Whole document	1-4
X	US 5311302 A (BERRY et al.) 10 May 1994 Abstract, figure 3, column 4 lines 47-51, column 6 lines 47-49	1-4
X	EP 1014708 A2 (SONY CORPORATION) 28 June 2000 Abstract, figure 6	1-4
X	Patent Abstracts of Japan, JP 2000-321533 A (IMABAYASHI YUJI) 24 November 2000 Abstract and drawing	1-3
P, X	Patent Abstracts of Japan, JP 2002-259052 A (NISSHA PRINTING CO LTD) 13 September 2002 Abstract	1-4
X	US 4879603 A (BERMAN) 7 November 1989 Abstract, figure 1, column 1 lines 13-19, column 2 lines 39-53	1, 3, 4
X	US 6271895 B2 (TAKAGI et al.) 7 August 2001 Abstract, column 1 lines 34-38, column 2 lines 3-67	1, 3, 4
X	US 5883739 A (ASHIHARA et al.) 16 March 1999 Abstract, column 6 lines 53-61	1, 3, 4
X	US 4028725 A (LEWIS) 7 June 1977 Abstract, figures 8A-9B, column 1 line 5 - column 2 line 52	1, 3, 4
X	FR 2742287 A1 (LABO TELE 34 SARL) 13 June 1997 Whole document	1, 3, 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ03/00133

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5978607	NONE					
WO	9932945	EP	1040391	US	6600527	EP	926574
US	5311302	EP	577054	JP	6282377		
EP	1014708	JP	2000184241	KR	2000048099		
JP	2000321533	NONE					
JP	2002259052	NONE					
US	4879603	EP	355957	JP	2089087		
US	6271895	EP	977071	JP	2000105348	US	6215532
		US	2001000677	JP	2000267038		
US	5883739	JP	7103784	JP	7105484	JP	7105485
		JP	7144578	JP	7143524	JP	7156685
US	4028725	NONE					
FR	2742287	NONE					

END OF ANNEX